Citation:

Krishnan S, Rosenberg L, Singer M, Hu FB, Djoussé L, Cupples LA, Palmer JR. Glycemic index, glycemic load and cereal fiber intake and risk of type 2 diabetes in US black women. *Arch Intern Med*. 2007 Nov 26; 167 (21): 2,304-2,309.

PubMed ID: 8039988

Study Design:

Prospective Cohort Study

Class:

B - Click here for explanation of classification scheme.

Research Design and Implementation Rating:

POSITIVE: See Research Design and Implementation Criteria Checklist below.

Research Purpose:

To examine the association of Glycemic Index (GI), Glycemic Load (GL) and cereal fiber intake with the risk of type 2 diabetes in a cohort of US black women.

Inclusion Criteria:

Black women >30 years of age living in United States from the Black Women's Health Study (BWMS).

Exclusion Criteria:

Women were excluded if:

- Reported diabetes at baseline
- Reported cancer or cardiovascular disease at baseline
- Pregnant at baseline
- Younger than 30 years old at end of follow-up
- Data on body mass index (BMI) was missing at baseline
- Incomplete dietary questionnaire or more than 10 dietary questions blank
- Implausible energy intake values
- Implausibly low GI values.

Description of Study Protocol:

Recruitment

- Women were recruited via the Black Women's Health Study, which began in 1995

- Women ages 21-69 were enrolled through postal questionnaires mailed to subscribers of Essence magazine, members of some professional organizations, and friends and family members of early respondents
- Only women 30 years and older were used for this study.

Design

Prospective follow-up study using the Black Women's Health Study.

Dietary Intake/Dietary Assessment Methodology

- Diet was assessed at baseline with a 68-item modified version of the short National Cancer Institute Block Food-Frequency Questionnaire (FFQ). It was modified to include items specific to a black population based on some write-in answers from a pilot study. The FFQ was validated with food diaries
- For each participant, overall dietary GL was calculated using this information and the values of GI and carbohydrate were obtained using standard databases. Cereal fiber content was calculated as well.

Blinding Used

Not applicable.

Intervention

Not applicable.

Statistical Analysis

Cox proportional hazards models were used to calculate incidence rate ratios (IRR) and 95% CIs. IRRs were estimated for the association of a particular dietary factor with the incidence of Type 2 diabetes in three models:

- The first included age
- The second added personal factors such as:
    - BMI
    - Energy intake
    - Family history of diabetes
    - Smoking
    - Physical activity
- The third model added other dietary factors.

Confounders included in the regression model were age, BMI, family history of diabetes, smoking, energy intake, fat intake and protein intake. Analyses were repeated separately for a BMI lower than 25 and a BMI of 25kg/m^2 or greater.

Data Collection Summary:

Timing of Measurements

- Diet and demographics were assessed at baseline in 1995
- Follow-up questionnaires were performed every two years (1997, 1999, 2001, 2003).

Dependent Variables

Variable 1: Type 2 diabetes.

Independent Variables

- Variable 1: Glycemic Index: The overall dietary GI was calculated by dividing the dietary GL by the total amount of daily carbohydrate intake
- Variable 2: Glycemic Load: Calculated by summing the products of the carbohydrate content per serving of the food times its GI times the mean number of servings of food per day
- Variable 3: Cereal Fiber Intake: Calculated by taking into account the recipe and changes due to cooking methods for each food item. Cereal fiber intake for each participant was then calculated by summing the products of cereal fiber per 100 g times the grams of food per serving times the number of servings per day.

Control Variables

None.

Description of Actual Data Sample:

- *Initial N:* 59,000 women
- *Attrition (final N):* 40,078 women
- *Age:* 30-69 years
- *Ethnicity:* Black women living in US
- *Other relevant demographics:* None
- *Anthropometrics:* None
- *Location:* All regions of the United States.

Summary of Results:

After controlling for BMI, energy intake, family history, smoking and physical activity, glycemic load was associated with risk of diabetes. Glycemic load was positively associated with diabetes risk in all three models, but this difference was **not** statistically significant. Irr=1.22 (95% CI: 0.98-1.51) for highest quintile of GL compared with lowest quintile GL for association with diabetes.

- **Glycemic index was significantly positively associated with diabetes risk**. In the mulitvariable model the IRR for the highest quintile of GI relative to the lowest quintile was 1.23 (95% CI: 1.05-1.44)
- **Cereal fiber intake was inversely associated with diabetes risk**. The IRR for the highest intake of cereal fiber relative to the lowest was 0.82 (95% CI: 0.70-0.96)
- When results were stratified according to BMI, the associations were still present in both BMI groups, but were stronger in the thinner women. The IRRs for the highest quintile of GI vs. the lowest were 1.91 (95% CI: 1.16-3.16) for those with BMI lower than 25kg/m^2 compared to 1.19 (95% CI: 1.01-1.40) for those with a BMI of 25kg/m^2 or greater
- The cereal fiber intake association with diabetes also remained when stratified by BMI group. The IRR for those with BMI lower than 25 was 0.41 (95% CI: 0.24-0.72) and was 0.88 (95% CI: 0.74-1.04) \for those with BMI of greater than 25kg/m ^{2}.

Author Conclusion:

Increasing cereal fiber in the diet may be an effective means of reducing the risk of type 2 diabetes a disease that has reached epidemic proportions in the black women.

Reviewer Comments:

None.

Research Design and Implementation Criteria Checklist: Primary Research

Relevance Questions		
1.	Would implementing the studied intervention or procedure (if found successful) result in improved outcomes for the patients/clients/population group? (Not Applicable for some epidemiological studies)	N/A
2.	Did the authors study an outcome (dependent variable) or topic that the patients/clients/population group would care about?	Yes
3.	Is the focus of the intervention or procedure (independent variable) or topic of study a common issue of concern to nutrition or dietetics practice?	Yes
4.	Is the intervention or procedure feasible? (NA for some epidemiological studies)	N/A

Validity Questions		
1.	**Was the research question clearly stated?**	Yes
1.1.	Was (were) the specific intervention(s) or procedure(s) [independent variable(s)] identified?	Yes
1.2.	Was (were) the outcome(s) [dependent variable(s)] clearly indicated?	Yes
1.3.	Were the target population and setting specified?	Yes
2.	**Was the selection of study subjects/patients free from bias?**	Yes
2.1.	Were inclusion/exclusion criteria specified (e.g., risk, point in disease progression, diagnostic or prognosis criteria), and with sufficient detail and without omitting criteria critical to the study?	Yes
2.2.	Were criteria applied equally to all study groups?	Yes
2.3.	Were health, demographics, and other characteristics of subjects described?	Yes

2.4.	Were the subjects/patients a representative sample of the relevant population?	Yes
3.	**Were study groups comparable?**	Yes
3.1.	Was the method of assigning subjects/patients to groups described and unbiased? (Method of randomization identified if RCT)	N/A
3.2.	Were distribution of disease status, prognostic factors, and other factors (e.g., demographics) similar across study groups at baseline?	Yes
3.3.	Were concurrent controls used? (Concurrent preferred over historical controls.)	N/A
3.4.	If cohort study or cross-sectional study, were groups comparable on important confounding factors and/or were preexisting differences accounted for by using appropriate adjustments in statistical analysis?	Yes
3.5.	If case control or cross-sectional study, were potential confounding factors comparable for cases and controls? (If case series or trial with subjects serving as own control, this criterion is not applicable. Criterion may not be applicable in some cross-sectional studies.)	N/A
3.6.	If diagnostic test, was there an independent blind comparison with an appropriate reference standard (e.g., "gold standard")?	N/A
4.	**Was method of handling withdrawals described?**	Yes
4.1.	Were follow-up methods described and the same for all groups?	Yes
4.2.	Was the number, characteristics of withdrawals (i.e., dropouts, lost to follow up, attrition rate) and/or response rate (cross-sectional studies) described for each group? (Follow up goal for a strong study is 80%.)	Yes
4.3.	Were all enrolled subjects/patients (in the original sample) accounted for?	Yes
4.4.	Were reasons for withdrawals similar across groups?	Yes
4.5.	If diagnostic test, was decision to perform reference test not dependent on results of test under study?	N/A
5.	**Was blinding used to prevent introduction of bias?**	N/A
5.1.	In intervention study, were subjects, clinicians/practitioners, and investigators blinded to treatment group, as appropriate?	N/A
5.2.	Were data collectors blinded for outcomes assessment? (If outcome is measured using an objective test, such as a lab value, this criterion is assumed to be met.)	N/A
5.3.	In cohort study or cross-sectional study, were measurements of outcomes and risk factors blinded?	???

5.4.	In case control study, was case definition explicit and case ascertainment not influenced by exposure status?	N/A
5.5.	In diagnostic study, were test results blinded to patient history and other test results?	N/A
6.	**Were intervention/therapeutic regimens/exposure factor or procedure and any comparison(s) described in detail? Were interveningfactors described?**	Yes
6.1.	In RCT or other intervention trial, were protocols described for all regimens studied?	N/A
6.2.	In observational study, were interventions, study settings, and clinicians/provider described?	Yes
6.3.	Was the intensity and duration of the intervention or exposure factor sufficient to produce a meaningful effect?	Yes
6.4.	Was the amount of exposure and, if relevant, subject/patient compliance measured?	Yes
6.5.	Were co-interventions (e.g., ancillary treatments, other therapies) described?	N/A
6.6.	Were extra or unplanned treatments described?	N/A
6.7.	Was the information for 6.4, 6.5, and 6.6 assessed the same way for all groups?	Yes
6.8.	In diagnostic study, were details of test administration and replication sufficient?	N/A
7.	**Were outcomes clearly defined and the measurements valid and reliable?**	Yes
7.1.	Were primary and secondary endpoints described and relevant to the question?	Yes
7.2.	Were nutrition measures appropriate to question and outcomes of concern?	Yes
7.3.	Was the period of follow-up long enough for important outcome(s) to occur?	Yes
7.4.	Were the observations and measurements based on standard, valid, and reliable data collection instruments/tests/procedures?	Yes
7.5.	Was the measurement of effect at an appropriate level of precision?	Yes
7.6.	Were other factors accounted for (measured) that could affect outcomes?	Yes
7.7.	Were the measurements conducted consistently across groups?	Yes
8.	**Was the statistical analysis appropriate for the study design and type of outcome indicators?**	Yes
8.1.	Were statistical analyses adequately described and the results reported appropriately?	Yes

8.2.	Were correct statistical tests used and assumptions of test not violated?	Yes
8.3.	Were statistics reported with levels of significance and/or confidence intervals?	Yes
8.4.	Was "intent to treat" analysis of outcomes done (and as appropriate, was there an analysis of outcomes for those maximally exposed or a dose-response analysis)?	Yes
8.5.	Were adequate adjustments made for effects of confounding factors that might have affected the outcomes (e.g., multivariate analyses)?	Yes
8.6.	Was clinical significance as well as statistical significance reported?	Yes
8.7.	If negative findings, was a power calculation reported to address type 2 error?	N/A
9.	**Are conclusions supported by results with biases and limitations taken into consideration?**	Yes
9.1.	Is there a discussion of findings?	Yes
9.2.	Are biases and study limitations identified and discussed?	Yes
10.	**Is bias due to study's funding or sponsorship unlikely?**	Yes
10.1.	Were sources of funding and investigators' affiliations described?	Yes
10.2.	Was the study free from apparent conflict of interest?	Yes